Risk Management

Public Perception of Risk

- Public concern about risk is wide ranging and the primary source for risk assessment comes from media sources
- The public tends to overestimate many varieties of risk when compared to expert opinion and quantitative factors such as mortality rates
- Even experts have difficultly agreeing on risk, but they have produced useful reports on relative risk
- Public often relies on outrage factors to define risk levels
  - Voluntariness, Control, Fairness, Process, Morality, Familiarity, Memorability, Dread, etc.
- Experts should pay attention to outrage factors, including education to decrease concern about light to med risks

Risk Assessment as a Regulatory Science

- In light of different approaches to risk assessment and relative "opinions" of risk, how should regulations be developed
- (Science vs. Opinion) vs. (Different Stakeholder Viewpoints)
- Is Risk Assessment Science or Opinion (or Both)?
  - Regulatory or Mandated Science is not strictly Science
- Objective Risk (Rational?) vs. Subjective Risk (Irrational?)
- Assumptions and Objectives can impact outcomes in both Risk Assessment and in Risk Management
- If risk assessment cannot be completely detached from politics, social values, public debate, democracy, and so on, how does this impact on the engineer's obligations to public welfare?

The Conceptual Risks of Risk Assessment

- Risk Assessment may be considered a "developing science"
- But is it objective and transparent? And can risk assessment itself create ethical dilemmas and introduce added risk?
- **"Risk is generally defined as a compound measure of the perceived probability and magnitude of adverse effect"**
- Standard Risk Assessment Methodology may use different approaches and each step involves bias and value judgments
  1. Risk Identification
     - Case clusters, comparisons, animal studies, bio-statistics, etc.
  2. Risk Estimation
     - Dose-response relationship, population at risk, exposure level
  3. Risk Evaluation
     - RCBA, revealed & expressed preferences, natural standards

Problems and Dilemmas of Risk Assessment

- Inhaber's Risk Assessment (AECB report in journal Science)
  - Found that solar and wind riskier than nuclear and coal. How?
  - Assumed all sources hooked to grid, alternative energy requires coal backup, equated radiation sick days or deaths to other risks
- Contributer's Dilemma
  - Accepting risks from cumulative effects of small acceptable risks
- Threshold Dilemma
  - Risk thresholds based on averages aren't evenly/fairly distributed
- Consent Dilemma
  - People who "consent" to higher risks might not be fully educated
- Possible solutions to improve systems
  - Use ethically weighted Risk Benefit Cost Analysis parameters
  - Use an adversarial system of assessment to generate alternatives
  - Involve the public

Technological Hazards and the Engineer

- Hazards originate from many different sources
  - Various case examples: Aluminum wiring, Oil Rig Alexander L. Kielland, Kanemi's Rice-Oil, Computer-Based Police Files, Fast Ships At Sea (Titanic), Lack of Commitment (Toxic Waste)
- Society's Response vs. the Engineer's Reaction
  - Society relies on laws such as Torts and Contracts and expects good design to have redundancy and fail-safes
  - Engineers recognize uncertainties and design using safety factors
  - Safety Factor = Design Limit / Operation load Limit
  - But simple safety factors aren't always enough (overlapping probability distributions, public policy objectives, etc.)
- To protect the public, engineers must take responsibility for risks and uncertainty, and engage in participatory processes

What do you Care what Other People Think?

- Richard Feynman on the Challenger Disaster
- Management, Astronauts, and Engineers all had different perceptions of risk – how did this impact on the design and disaster?
- "For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled." – Great Quote for Engineers!!
- Also a great book and a great physicist, author, personality…
- How does acceptance of risk apply to the Columbia disaster?

Is Idiot Proof Safe Enough?

- What is meant by "Idiot Proof"?
- Where does risk from uncertainties come from when designing new products?
- What are the biggest contributors to uncertainty?
- How might a rational design process remove uncertainty to deliver an "Idiot Proof" design?
- How can you assign probability to the "unknown"?
- How can Idiot Proof design methodology contribute to increased risk?

Sustainable Development

- "Our Common Future", Report of the World Commission on Environment and Development (Brundtland Report, 1987)
- What is "Sustainable Development"?
  - "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."
- How do we define "needs"?
- What are the limitations imposed on the environment by technology and social policy?

Lovelock's Gaia

- "Ages of Gaia", James Lovelock (Look out @ www)
- What is Gaia theory?
  - Life is a planetary scale phenomenon!
  - Life is immortal and does not need to reproduce!
  - There cannot be "partial occupation" of a planet.
  - Evolution pertains to species and even rocks as a whole!
  - Macro ecosystems may be considered more stable.
- Why is this relevant to engineers?

Engineer's Environmental Guidelines

1. develop and maintain a realistic level of understanding of environmental issues related to the engineer's field of expertise.
2. seek out and use as necessary the supplemental expertise of specialists to assess the environmental implications of engineering activities.
3. apply professional and responsible judgment with respect to environmental considerations.
4. ensure that environmental planning and management are integrated into all the engineer's professional activities.
5. in the evaluation of an engineering project, consider the cost of environmental protection for the entire life of the project including its final closure.
6. strive to have pollution prevention implemented at the production source and to manage wastes appropriately.
7. cooperate with public authorities, and strive to respond to environmental concerns in a timely fashion.
8. comply with legislation and consider where feasible, additional environmental protection.
9. work actively with others to improve environmental understanding and practices.